

brachial with the radial is weak, as is also the union between the first and second brachials. As a result the arms are seldom in true alignment and in their original positions.

Fortunately fragments of column have been found in such relationships with the *Allagecrinus* crowns as to leave no doubt as to their belonging together. The column figured lies on a set of arms and is incomplete in its proximal portion. The proximal columnals are thin and become narrower distad. This tapering proximal portion of the column is similar to that commonly found in the Flexibilia. Below the tapering columnals the character of the column changes completely. The columnals are beadlike, and the nodals are relatively large. The general aspect of the column is very like that of one of the young Flexibilia from the Devonian or Mississippian.

There is no described species of *Allagecrinus* with which *A. strimplei* may be confused.

Horizon and locality.—The specimens were collected by Mr. H. L. Strimple in the Dewey limestone (Pennsylvanian) near Dewey, Oklahoma.

Types.—The cotypes are in the Springer collection in the U. S. National Museum, No. S. 4126.

BIOLOGY.—*Food of Arctic birds and mammals collected by the Bartlett Expeditions of 1931, 1932, and 1933.*¹ CLARENCE COTTAM, U. S. Biological Survey. (Communicated by WALDO L. SCHMITT.)

On Captain R. A. Bartlett's three arctic expeditions in the summers of 1931, 1932, and 1933, alimentary material, mostly gullet and stomach or gizzard contents of 115 birds representing 21 species and one additional subspecies, was collected. This material, subsequently submitted to the Biological Survey for analysis, forms the basis for this paper. Fifty-three birds were secured on the first expedition during July and August from northwestern Greenland in the vicinity of Clavering Island, northward to slightly beyond the 74th parallel north latitude and between the 13th and 29th meridians west longitude. The second expedition returned with 20 birds from western and northern Greenland, northward to latitude 76° 33'. These birds, likewise, were taken during the months of July and August. Localities mentioned were Parker Snow Bay, Dalrymple Island, Cape York, Walstenholme, and North Star Bay in latitude 76° 33'. During the 1933 expedition, which extended from July to September, one weasel and five ground squirrels were collected in addition to 42 birds. Collections were made in the area between northern Hudson Bay and western Greenland. Localities recorded included Melville Peninsula; Duckett's Cove, Hudson Strait; Igloolik Island near Fury and Hecla Strait; Cape Frigid, Southhampton Island; and the open seas at latitude 61° north and longitude 64° 20' west.

¹ Received February 11, 1936.

Even though the number of individuals and species in the collections is not so large as one might wish, they are of more than ordinary importance as they represent a far northern area in which but little critical study of the food habits of birds has previously been made. The majority of these species were poorly represented, or even entirely wanting in the "stomach files" of the Biological Survey.

While the writer examined the majority of the stomachs submitted, generous assistance in this regard was received from A. L. Nelson, Cecil S. Williams, Leon H. Kelso, and F. H. May, all of the staff of the Biological Survey food-habits research laboratories. Specialists who aided by making identifications of questionable material include: Dr. Waldo Schmitt and Clarence Shoemaker, of the U. S. National Museum, on crustaceans; F. M. Uhler, of the Biological Survey, fishes; Wm. B. Marshall, of the U. S. National Museum, mollusks; J. R. Malloch, of the Biological Survey, two-winged flies (Diptera); and Dr. R. V. Chamberlin, of the University of Utah, spiders.

A summary of the food percentages by volume as determined from the analysis of stomachs, gullets, or crops of the birds collected on these expeditions follows:

Gavia stellata (Pontoppidan). Red-throated Loon.

Five adult and two juvenile stomachs of the red-throated loon provide convincing evidence that the birds' piscivorous tendencies dominate. Two adult stomachs were taken from Clavering Island, northeast Greenland, two from Igloolik Island, northwest Greenland, and one from Cape Frigid, Southampton Island, Northwest Territory. Four of these adult birds had made their entire meals on small coarse fish, largely Gadidae (? *Boreogadus saida*), sculpins (Cottidae), and tomcod (*Microgadus tomcod*), while the other had made 80 percent of its meal on sculpins (Cottidae), tomcod (*Microgadus tomcod*) and sand lance (*Ammodytes* sp.). The remaining 20 percent of the meal of this bird consisted of 54 polychaete (marine) worms, apparently a species of Nereidae.

The food of these five adult birds would be summarized as follows: Cottidae, 34.2 percent; tomcod (*Microgadus tomcod*), 4.8 percent; *Ammodytes* sp., 2 per cent; codfish (Gadidae, part probably *Boreogadus saida*), 30 percent; miscellaneous fish, 25 percent; polychaetes, apparently Nereidae, 4 percent; copepoda and undetermined crustacea (which may have come from the stomach of a partly-digested fish), trace.

From the size of the stomachs of the two juvenile birds, taken at Igloolik Island, it would appear that the birds were probably three-fourths grown. It is evident that the food of adults and juveniles varies considerably. Perhaps because the young are less agile and therefore less expert as fishermen, they consume fewer fish. In the two birds examined a greater variety of food was noted than in the adults. It was surprising to find that a moss of the family Hypnaceae made up 43 percent and 33 percent respectively of the two meals. It was noted that all the moss was in the gizzard and from appearance it had

been there for some time. Perhaps in this group of birds the effects of digestive action are less rapid on plant than on animal substances. Feathers are often found in quantity in the stomachs of loons and grebes, yet their function is not definitely known. Some have believed that they serve to protect the stomach walls against the sharp fish bones. It is not known whether the moss in these juvenile birds' stomachs was serving as a source of food, or, similarly, as a protection to the tender, growing gastric organ against the sharp fish-bone fragments.

The stomachs and gullets of both juveniles were well-filled and may be thus summarized: Tomcod (*Microgadus tomcod*), 59.5 percent; sculpin (*Cottidae*), 5 percent; polychaetes, apparently Nereidae, 2 percent; squid (*Loligo* sp.), 0.5 percent; moss (*Hypnaceae*) plant fiber, 38 percent; gastropods, trace; crustacea, including amphipoda and schizopoda (which may have been taken by the fish), trace.

Fulmarus glacialis glacialis (Linnaeus). Atlantic Fulmar.

Because the Biological Survey has no other record of a stomach examination of the Atlantic fulmar it is to be regretted that only one well-filled stomach of this bird was submitted for examination. It was collected at 61° north latitude and 32°10' west longitude. This stomach contained the rather indigestible fragments of the lenses of fish eyes from a preceding meal, amounting to 1 percent of the total food content. Fragments of two squid (*Loligo pealei*) made up 11 percent of the food consumed, and finely ground fragments of an unidentifiable mollusk, 1 percent. The remains of 52 marine worms (Nereidae) formed the bulk of the meal, amounting to 86 percent of the total stomach content. Wood fibers and vegetable debris constituted the remaining 1 percent. Many small parasitic gizzard worms (Nematodes) were also found in the stomach. Two bird lice collected from the bird's plumage were identified by Dr. H. E. Ewing of the Bureau of Entomology as *An-cistrona vagelli* Fab.

Branta leucopsis (Bechstein). Barnacle Goose.

Only one stomach of the rare barnacle goose was included, and it was only about one-fourth filled with finely ground vegetable fiber. Of this, 40 percent was sedge (*Scirpus* sp.), 35 percent grass fiber (probably *Poa* sp.), and the remaining 25 percent was unidentifiable. Sixty-one percent of the total stomach content consisted of fine sand. Løppenthin (6, p. 42) in his studies of Greenland birds states that he found grass, leaves, and stems of serpent-grass (*Polygonum viviparum*) and mountain sorrel (*Oxyria digyna*) in stomachs of this species.

Clangula hyemalis (Linnaeus). Old Squaw.

One stomach of the old squaw, or long-tailed duck, was obtained from the far north (Cape Frigid) and unfortunately it was too nearly empty to shed much light on the normal food preferences. The following items, however, were noted: Fragments of midge (Chironomidae) larvae; soft-bodied crustacea too finely comminuted for identification; sessile barnacles (Balanidae); limpet shells (*Acmaea* sp.); bivalves (pelecypoda) too finely broken to indicate species; seed fragments and plant fiber of sedge, probably *Carex* sp.; moss; and undetermined plant fiber. A fairly large series of stomachs of this attractive bird, examined in the Biological Survey, indicates that it feeds largely on crustaceans and mollusks.

Somateria mollissima borealis (Brehm). Northern Eider.

Information obtained from examination of five well-filled stomachs of the northern eider, collected at Clavering Island, northeast Greenland, on August 6, and compared with two stomachs collected on the New England coast in February and March of earlier years, suggests that this northern duck consumes a higher percentage of fish in summer than it does in winter. Furthermore, these five examinations indicate that this species probably eats more fish than do other eider ducks. Fishes of the family Cottidae (sculpin) were found in each of the five stomachs examined and ranged from 2 percent in one stomach to 79 percent in another, with an average of 26 percent of the total food content for the five stomachs. The number of individual fishes eaten varied from 1 to 25, with two birds each consuming the latter number.

As would be expected, mollusks constituted the largest percentage of the food, averaging 65 percent of the total. In bulk this was nearly equally divided between bivalves and univalves, the former averaging 33.4 percent and the latter 31.6 percent. A species of soft-shelled clam (*Mya* sp.) occurred most frequently and amounted to 16 percent of all food taken. Other bivalves, occurring in about the order of their importance, were the arctic rock-borer (*Saxicava arctica*), the common edible mussel (*Mytilus edulis*), and another mussel (*Crenella* sp.). Of the univalves, the whelks (*Buccinum* sp. and *Tritonofusus* sp.) occurred in each of the five stomachs and averaged 5.6 percent and 3 percent respectively of the total food content. A species of moon shell (*Natica* sp.) occurred in four stomachs and a bubble shell (*Bulla* sp.) occurred in one. Gastropods too thoroughly disintegrated to be accurately named made up 20 percent of the total food consumed.

Soft-bodied crustacea formed 7.2 percent, amphipoda (mainly *Atylus carinatus* and *Corophium* sp.) being most important. Fragments of cumaceans and isopods were recognizable in two of the stomachs.

Fragments of the following minor items made up 0.4 percent of the total food: Protozoan (Foraminifera); worms (Annelida); starfish (Asteroidea); and beetles (Coleoptera). Vegetable food, consisting of sedge and moss plant fiber and algae, formed 1.4 percent.

Gravel is found in practically all duck stomachs, and in these five northern eiders, it made up 11.6 percent of the total stomach content. This, however, was not figured in the food percentages. A few feather fragments—most probably from the bird's own plumage—were found in one stomach. Feather fragments are frequently found in the stomachs of many birds, and particularly is this true of most waterfowl.

The five stomachs examined contained an average of more than 12 items per stomach. In contrast to this, the two winter birds collected along the New England coast contained only mollusks. One of these was filled with the common edible mussel (*Mytilus edulis*) and the other, which was nearly empty, contained fragments of the common mud snail (*Nassa obsoleta*).

Falco rusticolus candicans (Gmelin). White Gyrfalcon.

Five stomachs of the white gyrfalcon were obtained during the third expedition on different dates in August and September at various points on the Melville Peninsula. The stomach and small intestines of one bird were entirely empty of food, but contained many tapeworms.

Of the other four birds, one had made its entire meal on 2 collared lemming mice (*Dicrostonyx rubricatus richardsoni*) and another had made 97 per cent of its meal on 3 of these rodents, a horned lark (*Otocoris alpestris*) making up the remaining 3 percent of the food. The Melville Peninsula is

regarded as representing the northern border of the range of this rodent. The third gyrfalcon had in its stomach the remains of one red-backed mouse (*Evotomys* sp.) but, unfortunately, digestion had proceeded too far to permit accurate specific identification. *Evotomys gapperi*, according to Preble (8, pp. 50-51), is the species extending north to the Fort Churchill area. His brother, Alfred E. Preble, according to the report (Preble, 1902, p. 51), collected one specimen 15 miles north of this locality. It is not known what race occurs in the Melville Peninsula area, a region from 600 to 900 miles north of the record cited by Preble, which is the northernmost record in eastern North America. It is not improbable therefore that the specimen obtained from the falcon's stomach, which marks a notable extension of the range of this genus, is a new race or species of *Evotomys*.

The fourth gyrfalcon had made its entire meal of a luckless willow ptarmigan (*Lagopus lagopus albus*). While it is evident from the limited data available that this raptor does not shun bird food, the facts also indicate that rodents likewise are taken in numbers and probably are equally acceptable as an article of diet. Most published comments of the food habits of this bird would lead us to believe that only game and other birds enter into its diet. Bendire (1, p. 282) writes that "The natives assured me that they [the falcons] repair to the rugged mountains . . . to breed, and that they fed their young on the rock ptarmigan, which also seek that region for the same purpose. As a rule, these rocky cliffs are the summer homes of innumerable waterfowl, on whose young, as well as on ptarmigan, they prey to a great extent during the season of reproduction." Hagerup (3, pp. 292-293) writes of ptarmigan serving as the source of food for the bird in southern Greenland. Kumlien (5, p. 84) in his account of arctic American birds states that this falcon subsists wholly on ptarmigans and hares during the winter, and that while on his frequent excursions upon Disko Island he often had opportunity of witnessing the hawk preying upon jaegers, kittiwakes, and other birds. He added that he was surprised that this predator does not possess swifter powers of flight and stated that "their success seems to depend more upon a stubborn perseverance than alacrity of flight." Macmillan (7, p. 409) concludes that it feeds on eider ducks, Mandt's guillemots, ptarmigan, dovekies, and arctic hares. Other writers also mention that birds form its principal source of food. Stomach examination, however, indicates that rodents and other small mammals enter prominently into the species' bill of fare.

Falco peregrinus anatum (Bonaparte). Duck Hawk

Two young birds taken on the Barrow River, Melville Peninsula, August 29, 1933 were available for food habits study. One bird had made its entire meal on a Richardson collared lemming (*Dicrostonyx rubricatus richardsoni*) while the other had its stomach filled with bird bones and feathers, 40 percent of which was from a phalarope, apparently *Phalaropus fulicarius* and 60 percent from a red-backed sandpiper (*Pelidna alpina sakhalina*).

Lagopus rupestris reinhardti (Brehm). Reinhardt's Ptarmigan.

The contents of three stomachs with crops of Reinhardt's ptarmigan, collected August 6, at Clavering Island, were on hand for stomach analysis. All these apparently were fairly well filled, the contents indicating that this subspecies has food habits much in common with other varieties of ptarmigan. They are all highly vegetarian and seem to choose the vegetative

and succulent parts of many herbs and shrubs. It is interesting to note that each ptarmigan collected for this study had taken a trace of insects or spiders, yet of the total food content, animal matter equalled only 0.3 percent, with 2 percent as a maximum for one stomach. This bird had taken three species of flies, dungflies (*Scatophaga furcata*), dance flies (*Rhaphomyia* sp.) and *Spilogona* sp. and one spider (*Dictyna* sp.). One other bird had taken one ant (*Formica* sp.) and one fly (*Spilogona* sp.).

Bulblets of serpent-grass (*Polygonum viviparum*) were the dominant item, averaging 44.8 percent of all food consumed. One crop contained no fewer than 2,300 of these bulblets, which formed 100 percent of the food, while another had consumed more than 1,200, making it 87 percent of the meal. The flowers with mature akenes and leafy fragments of White Mountain avens (*Dryas octopetala*) ranked second in importance, averaging 19.4 percent of the total food of the three birds and amounted to 48 percent of the meal of one. The scales, spikes, and akenes of short-leaved sedge (*Carex misandra*), constituting 18.9 percent of the total average, made this species only slightly less important. One stomach contained about 500 akenes and fragments of probably 20 spikes of this species of sedge, which was 86 percent of that meal. The other contents were: Buds, leaves, and stems of an arctic willow (*Salix* sp.), 5.1 percent; seeds of alpine bearberry (*Arctostaphylos alpina*), 3.3 percent; leaves and stems of purple saxifrage (*Antiphylla oppositifolia*, 3.1 percent; seeds and fruiting bodies of sedge (*Carex nardina*), 2.8 percent; fruiting and leafy portions of spiked wood-rush (*Juncoides spicatum*), horsetail (*Equisetum* sp.), sandwort (*Arenaria* sp.), crowfoot (*Ranunculus* sp.), twisted whitlow grass (*Draba incana*), hairy lousewort (*Pedicularis hirsuta*), lousewort (*Pedicularis* sp.), speedwell (*Veronica* sp.), 2.3 percent.

There was an average of 12 species of food items per bird. While 17.7 percent of the total stomach and crop content was gravel, this was not computed as a part of the food contents.

Arenaria interpres interpres (Linnaeus). European Turnstone.

From an examination of three stomachs, collected August 7 at Hudson Land, northeastern Greenland, it would seem that the arctic individuals of the European turnstone are more or less omnivorous in their feeding habits. These three birds contained an average of twelve species of items per stomach with a total of twenty-one. The three stomachs contained 74.67 percent animal tissue and 25.33 percent plant fiber. Gravel (not included in food percentages) amounted to 22 percent of the total stomach contents. Those food items found in excess of 1 percent of the total, were: Crustaceans (mainly amphipods), 23.3 percent; diptera (two-winged flies, mainly crane-flies Tipulidae and Anthomyiidae), 20.9 percent; wood and other plant fiber, 13 percent; algae, 12.34 percent; sea-squirt, or ascidian, 9.3 percent; spiders and salt-water mites, 6 percent; brittle-stars (Ophiuroidea), 5 percent; bees and wasps (hymenoptera, mainly Ichneumonidae), 3.67 percent; beetles (coleoptera), 2.67 percent; butterflies (Lepidoptera), 1.7 percent; snails (gastropoda), 1 percent. Fragments of fish and a marine worm made up the remaining 1.12 percent.

Løppenthin (6, p. 55) found midges, snakeflies, the larvae of a crane-fly (*Tipula* sp.), larvae of caddice flies (Trichoptera), a few ichneumon flies (Ichneumonidae), a spider, fragments of a phalangid (*Mitopus morio*) which previously had not been recorded so far north in eastern Greenland and gravel in the stomachs of a number of birds examined.

Calidris canutus rufus (Wilson). American Knot.

An examination of the stomach content of four adult and two juvenile American knots collected on the second expedition at Parker Snow Bay, west Greenland, revealed that this bird has a varied diet. The four adults had subsisted largely upon plant fiber and rootlets, which they had finely pulverized. Each bird had made most of its meal on this material. It was somewhat surprising that vegetable substance entered so prominently into the bill-of-fare, forming 93 percent of the adults' and 24 percent of the juveniles' food. Dipterous forms, largely larvae, were the principal animal food of the young birds, while snails (gastropoda) and undetermined fragments of mollusks comprised the chief source of protein food for the adults.

A summary of the food of these birds follows:

Four adults.—Fragments of gastropods and unidentified mollusks, 6.25 percent; midges (Chironomidae) and other flies (Diptera), mostly larvae, 0.75 percent; spider, trace; crustaceans, trace; fish (taken by one bird), trace; bird louse (*Degeeriella* sp.), trace; moss plant fiber, 1.25 percent; Phippsia grass (*Phippsia* sp.), 16.25 percent; undetermined plant fiber and rootlets, 75.50 percent.

Two juveniles.—Fragments of midges (Chironomidae), mostly larvae, 27 percent; salt flies (Ephydriidae), 17.50 percent; two-winged flies (Diptera), too broken to permit more specific identification, 11.50 percent; bees and wasps (Hymenoptera), 6 percent; spiders, 2.50 percent; univalves (gastropoda) and undetermined mollusca, 4.50 percent; amphipoda, 4 percent; moss, 1 percent; meadow grass (*Poa* sp.), foxtail grass (*Alopecurus* sp.), cinquefoil (*Potentilla* sp.), and willow (*Salix* sp.), each 0.50 percent; fragment of undetermined grass (Gramineae), 10 percent; sedge (*Carex* sp.), 4 percent; and undetermined plant fiber and rootlets, 10 percent.

K. Henriksen, according to Løppenthin (6, p. 58) found the birds in northeast Greenland feeding on midges and stems of serpent-grass (*Polygonum viviparum*).

Phalaropus fulicarius (Linnaeus). Red Phalarope.

Two red phalaropes were collected by the third expedition on July 20, 1933 at latitude 61° north and longitude 24°20' west, but unfortunately the stomachs of both birds were only partly filled, although several items of food were noted. The following items in their approximate percentages were recorded for the two separate birds: No. 1. Fragments of lace-winged flies (Chrysopidae, probably *Chrysopa* sp.), two-winged flies (Ephydriidae, Chironomidae, Syrphidae, Asilidae, *Megaselida* sp., Dolichopodidae, and undetermined Diptera), squash bugs (Coreidae) and other Hemiptera, sawflies (Tenthredinidae), grasshoppers (Orthoptera) and beetles (Coleoptera), 90 percent; pulp of some seeds, probably sedge (*Carex* sp.), and vegetable debris, 10 percent. No. 2. Fragments of waterboatmen (Corixidae), 25 percent; fragments of midges (Chironomidae) and robber flies (Asilidae), 25 percent; seed pulp and one seed of sedge (*Carex* sp.), 50 percent.

Stercorarius parasiticus (Linnaeus). Parasitic Jaeger.

The stomach of one July specimen, taken in the Greenland Sea, at 73°32' north latitude and 17°10' west longitude, contained the remains of five or more tomcod (*Microgadus tomcod*), forming 41 percent of the meal. The remains of many crustacea, mainly amphipods (*Themisto libellula*) made up the remaining 59 percent. It is not known whether this food or the meals of

the two succeeding species were captured direct or resulted from forced regurgitations by other birds.

Løppenthin (6, pp. 84-85) states that in an adult female's stomach a lemming mouse was found. A juvenile bird had 3 small fishes in its gullet, while its stomach contained fragments of fish and a lemming mouse besides pieces of grass, stems, and gravel.

Stercorarius longicaudus Vieillot. Long-tailed Jaeger.

Two specimens of the long-tailed jaeger were collected on the same date and in about the same part of the Greenland Sea as the preceding species. Like the parasitic jaeger, these birds also had their stomachs filled with fish and crustaceans, suggesting that their food habits, when the birds occur in the same general region, are very similar. One stomach contained the remains of ten fish (seven of which were tomcod) besides considerable crustacean material. Fish (tomcod and an undetermined species) formed 29.5 percent of the total, while the following crustaceans made up the remaining 70.5 percent: schizopods (*Thysanoessa inermis*), 37.5 percent; amphipods, including *Themisto libellula*, 17.5 percent and *Gammarus locusta* 2.5 percent; and unidentifiable soft-bodied crustaceans, 13 percent.

Løppenthin (6, p. 93) comments that numerous items are taken as food by these birds. In good lemming years he says the birds subsist largely on these creatures. In other years as was the case in 1930, he states that they are forced to search for other food. He reports that the contents of one stomach of a bird taken near a lake was full of insects, lemmings, and gravel. A whelk (*Buccinum* sp.) was found in the stomach of another. Still another contained a cutworm (noctuid) larva, 1 adult and 1 larva of the brush-footed fly (*Argynnis* sp.), 2 *Dasychira groenlandica*, and a few crane-flies (*Tipula* sp.), along with the remains of a lemming. One bird was observed to contain a green berry in its bill. He cites an example of this jaeger pursuing a snow bunting and comments that these and other small birds are occasionally taken.

Larus hyperboreus Gunnerus. Glaucous Gull.

Ludwig Kumlien, in his report on the Howgate polar expedition of Arctic America (5, p. 97), noted that the glaucous gulls are extraordinarily greedy and voracious, that "nothing in the animal kingdom seems to come amiss to them. . . . Eggs, young or disabled birds, fish, and crustaceans are their common fare." He states further that they are very fond of feeding upon seal carcasses.

Results obtained in the present investigation of six well-filled, and one other stomach collected in July between 73° and 75° north latitude and 15° and 17° west longitude, and three stomachs taken in the same month at Cape York, northern Greenland, along with two taken in August at Dalrymple Island, northern Greenland, bear out this bird's reputation of being a scavenger and quite an omnivorous feeder. The results also suggest that depredations upon other bird life may at times be serious. Of the number of birds collected, seven of the full stomachs were from adults and four from juveniles.

Characteristic of most other species, the juvenile birds had consumed a much larger variety of foods than had the adults. Remains of other birds were also more numerous in the juvenile stomachs, suggesting that these birds had been hatched in the immediate neighborhood of other seafowl.

The accompanying table summarizes the food of the birds as analyzed in the Biological Survey Laboratory. Where genus only is given species could not be determined.

From the tabulation it is noted that coarse fish were first in importance with the adults, forming more than half (57.14 percent) of the total food consumed; while birds were second, amounting to 28 percent. It was somewhat surprising to find that these two items were almost of equal value with the young birds, fish (tomcod) totaling 43.50 percent, and birds comprising 45 percent. The presence of decayed seal (*Phocidae*) flesh confirms the bird's reputation as a scavenger and carrion feeder. The kelp and other plant substances taken by the young birds were taken incidental to the process of learning to feed and forage for themselves.

Pagophila alba (Gunnerus). Ivory Gull.

Only one heavily gorged stomach and gullet of the ivory gull, taken at latitude 74°05' north and longitude 17°15' west, was submitted for examination. Fragments of a tomcod made 1 percent of the meal, while the remaining 99 percent consisted of fragments of soft-bodied crustaceans as follows: 115 schizopods (*Thysanoessa inermis*), 95 percent; 5 amphipods (*Apherusa glacialis*), 1 percent; copepods, trace; other undetermined crustaceans, 3 percent.

Rissa tridactyla tridactyla (Linnaeus). Atlantic Kittiwake.

The single stomach of the Atlantic kittiwake, taken June 22, at latitude 62°30' north and longitude 29°07' west was fairly well filled with fish bones, predominantly tomcod and a species resembling the *Engraulidae*. Ninety-nine percent of the total food content was fish, while fragments of one undetermined damselfly (*Zygoptera*) made up the remaining 1 percent. In addition there was a trace of plant fiber.

Sterna paradisaea Linnaeus. Arctic Tern.

Only three stomachs of the Arctic tern from the north Greenland seas were submitted for examination. These were collected in July between 73° and 74° north latitude and 15° and 17° west longitude. These contained 33.67 percent fish, mainly tomcod (*Microgadus tomcod*); 65.67 percent soft-bodied crustaceans, mainly schizopods (*Thysanoessa inermis*); and a fraction of one percent of vegetable debris. One of these 3 birds was a juvenile that had fed solely on crustaceans, mostly *Thysanoessa inermis*.

Uria lomvia lomvia (Linnaeus). Brunnich's Murre.

Of seven stomachs collected in July 1931, between 72° and 73° north latitude and 13° and 18° west longitude, only three were well-filled. On the second expedition two birds of this species, collected at Parker Snow Bay, western Greenland, were submitted—only one being full. On the third arctic trip, 34 additional birds were collected near Hudson Strait, Resolution Island and Salisbury Island. Of these, 31 were sufficiently full to be used in the computation of food percentages.

From an analysis of these stomachs it is evident that Brunnich's murre

subsists principally on but few species of items. One amphipod species (*Themisto libellula*) occurred in all but one stomach and comprised 90.37 percent of the entire food consumed. Nearly two-thirds of the birds had taken this large amphipod to the extent of 100 percent of their meals, a number consuming no fewer than a hundred individuals. In a few of these stomachs other items occurred, but amounted to only a trace in the food. Other amphipods amounting to 1.40 percent included *Gammarus locusta*, *Pseudalibrotus nansenii*, and *Gnathia maxillaris*. The schizopod (*Thysanoessa inermis*) was apparently acceptable when available, as one murre had consumed more than 125 of these creatures, comprising 87 percent of its meal. But four of the birds had fed on these crustaceans and in total they formed 5.51 percent of the entire food intake. Undetermined soft-bodied crustaceans formed 1.20 percent, and in the aggregate, crustaceans formed 98.48 percent of all food consumed by the 35 birds. Fish, mostly sculpin (Cottidae), were fed upon by three birds and formed 1.06 percent of the food. The remaining 0.46 percent of the average meal consisted largely of polychaete worms, probably Nereidae. While their mandibles occurred in 9 stomachs, they usually formed but a trace in the food. Plant fiber occurred as a trace in two stomachs.

The principal items noted in the stomachs but not figured in the computations included squid (*Loligo* sp. which formed the principal item in one stomach one-tenth full), undetermined crustaceans, and fish.

Alle alle (Linnaeus). Dovekie.

Seven well-filled stomachs with five full gullets from dovekies collected on ice floes early in July from the north Greenland polar seas (between lat. 72° and 74° N. and long. 13° and 18° W.) were available for the present study. They reveal that this species shares the well-known propensity of many northern sea birds to feed extensively on soft-bodied crustaceans, as all but a mere trace of food in each of two stomachs consisted of these small aquatic creatures. One stomach contained a few fragments of fish bones and another a trace of an unidentifiable bone. A common and apparently an easily obtainable schizopod (*Thysanoessa inermis*), constituted the dominant item in all the gullets and in five of the stomachs, averaging 57.86 percent of the total food consumed by the seven birds. One bird had devoured no fewer than 133 of these reddish shrimp-like creatures while other stomachs showed remains of 75, 56, 53, and 33, respectively. Amphipods (Hyperiidæ, *Gammarellus* sp. and *Themisto libellula*) amounted to 16.57 percent of the total, while fragments of unidentifiable crustaceans, probably consisting largely of the schizopods and amphipods herein listed, made up the remaining 25.57 percent of the total food consumed. It was interesting to note that a trace of feathers was found in four of the seven stomachs.

Cephus grylle grylle (Linnaeus). Black Guillemot.

If the two available July stomachs of the black guillemot can be taken as a criterion, its summer food in the North Atlantic consists of an unusually high percentage of fish. The two stomachs contained 79.5 percent tomcod (*Microgadus tomcod*), 12 percent undetermined fish bone fragments, and 8.5 percent fragments of amphipods and undetermined crustaceans.

Cephus grylle mandti (Mandt). Mandt's Guillemot.

Five stomachs of Mandt's guillemot were obtained from North Star Bay (lat. 76°33' N.) and Dalrymple Island, northern Greenland and Wolsten-

holme, western Greenland. Of these, three were juvenile birds two of which contained but little food. The other juvenile stomach being but one-fifth full, had made 10 percent of its meal on fish, 10 percent on the gastropods (*Margarites* sp.), 8 percent on undetermined gastropods, 15 percent on the crustacean, *Harpacticus uniremis*, 25 percent on amphipoda, including *Pseudalibrotus litoralis* and Oedicerotidae, and 32 percent on undetermined crustaceans, probably mostly amphipods. The other juvenile birds had taken fish, squid, crustaceans, gastropods, annelid worms, and plant fiber.

The two adult birds, while consuming much of the same kinds of food, had subsisted more heavily on fish. One bird had consumed 14 sculpins (Cottidae), representing 3 species. Undetermined fish comprised 4 percent of the total while crustaceans, including *Spirontocaris polaris*, *S. fabricii*, *S. gaimardii*, *Harpacticus uniremis*, and *Amenophia peltata*, constituted 37 percent. Bivalves, squid (*Loligo* sp.), and annelids each formed 0.50 percent of the total.

As would be expected, the two races of guillemots are similar in their food habits.

Hantzsch (4, p. 90) states that "six stomachs [of Mandt's guillemot] contained in four cases fish remains, one digested crustacean remains, unmistakable prawn remains, one *Gammarus* and one small snail." Bent (2, p. 164) asserts that "the food of Mandt's guillemot seems to consist mainly of small fishes, crustaceans, and other soft-bodied sea animals."

Corvus corax principalis Ridgway. Northern Raven.

The stomachs of two northern ravens, one taken near Parker Snow Bay and the other at Dalrymple Island, furnish evidence that this northern race is as predacious and omnivorous in its food tendencies as any of its relatives farther south. The stomach contents from the two meals are as follows: No. 1. Parts of 1 chinch bug (*Nysius groenlandicus*), trace; fragments of 5 horsefly pupae (Tabanidae), 1 percent; bird egg fragments, 2 percent; bird feathers and bone fragments not positively identified, but possibly from the dovekie (*Alle alle*), 10 percent; carrion and hair fragments of reindeer (*Rangifer groenlandicus*), 40 percent; other (?) carrion, 6 percent; moss plant fiber of 2 species, 1 percent; 88 berries and 125 additional seeds, fruit pulp, floral parts, and leafy fragments of the cowberry (*Vaccinium* [*? vitis-idaea*]), 26 percent; 20 berries, fruit pulp, and 8 additional seeds of the crowberry (*Empetrum nigrum*), 8 percent; plant fiber and floral parts of bent grass (*Agrostis* sp.), 1 percent; plant fiber and floral parts of meadow grass (*Poa* sp.), 1 percent; plant fiber of undetermined grass (Gramineae), trace; seed fragments and plant fiber of sedge (*Carex* sp.), 1 percent; leafy fragments of a heath, possibly *Cassiope* sp., trace; undetermined plant fiber, 3 percent. No. 2. Parts of bird, undetermined, 15 percent; fragment of bird egg, about the size and color of that of a duck, 1 percent; fragments of mammalian carrion, 10 percent; fragments of an undetermined insect, trace; fragment of mollusks, trace; 9 berries and 11 additional seeds of the crowberry (*Empetrum nigrum*), 60 percent; moss plant fiber, 1 percent; undetermined plant fiber, 13 percent.

Mustela arctica arctica (Merriam). Weasel.

But one partly-filled stomach of this weasel was available for laboratory study and it contained fragments of a single item—a lemming mouse (probably *Lemmus trimucronatus*).

Citellus parryii parryii (Richardson). Hudson Bay Ground Squirrel.

Five stomachs of the Hudson Bay ground squirrel show that, like its more southern congeners, it is primarily a vegetarian. While a fairly large number of plant foods were consumed, two items—vetch (*Astragalus* sp.) and sedge (*Carex* sp.)—appeared in each stomach examined, and formed 73.40 percent and 14.20 percent respectively of all food taken. Smartweeds (*Polygonum* sp.) formed 8 percent, while wood rush (*Luzula* sp.), rush (*Juncus* sp.) and rose (Rosaceae) formed 0.6, 0.2, and 0.2 percents respectively. Unidentified plant debris aggregated 1 percent. Other vegetable foods occurring as a trace included: Moss, grass (Gramineae), waterbuttercup (*Ranunculus* sp.), cinquefoil (*Potentilla* sp.), Labrador tea (*Ledum groenlandicum*), and blueberry (*Vaccinium* sp.).

Four of the five ground squirrels had fed to a limited extent on the larvae of craneflies (*Tipula* sp.) which averaged 2.40 percent of the food. One animal also had the remains of fish from a preceding meal in its stomach. This, however, formed but a trace of the total food.

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BOTANY.—*Three new grasses from Polynesia.*¹ JASON R. SWALLEN,
Bureau of Plant Industry.

The following new species were in a large collection of grasses recently received for study from the Bernice P. Bishop Museum, Hawaii. One was collected on the island of Rapa, one on Raiatea, Society Islands, and the other on Aiwa, Fiji Islands.

Aristida aspera Swallen, sp. nov.

Perennis; culmi dense caespitiosi, erecti, nodis geniculati, asperi, 40-60 cm alti, ramis dense fasciculatis; vaginae internodiis elongatis breviores, scaberrulae; ligula 0.2 mm longa; laminae planae vel involutae, flexuosae vel falcatae, 2-8 cm longae, 1-2 mm latae, glabrae; paniculae 3-10 cm longae, ramis appressis paucifloris remotis; spiculae appressae vel divergentes;

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